Concrete-Filled-Tube Column-to-Cap-Beam Welded Connection Detail

PEER Internship Program – Summer 2013

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This research was conducted at the University of Washington (UW)

Introduction

PEER

Concrete-filled tubes (CFTs) provide several advantages over traditional reinforced concrete or hollow steel columns.

Steel tube

- Replaces formwork
- Replaces reinforcing steel
- Confines concrete, increasing strength and strain capacity Increases flexural capacity

Concrete fill

- Delays buckling
- Increases axial capacity

ring of grouted precast headed bars inverted-t

Results

- Failure mode was reinforcing bar fracture in all cases, as shown by observation and force-displacement data.
- No weld damage observed.
- Significant concrete damage during bonded bar pullout.



However, there are no standardized connection details for CFT columns. Current UW research focuses on column-to-cap beam connections, including the connection in Figure 1.



Figure 1: Caltrans proposed CFT column-to-cap beam connection.

Research Objective

To evaluate the parameters affecting the proposed welded reinforcing-bar-to-steel-tube connection

Methods

Pullout test performed on 24 reinforcing bars welded into CFT as specified by Caltrans design.

Specimen Construction



Test Setup

Experimental Parameters

- Bar bonding
- Weld strength
- Bar size
- Embedment depth

Figure 6: Representative force-displacement curves for each bar size. Force normalized by theoretical bar yield strength P_n . Displacement normalized by embedded length L_{e} .



Figure 7: Typical failed No. 7 reinforcing bar.



bar was bonded to concrete





bar was de-bonded with PVC



Figure 8: Concrete damage from No. 11 reinforcing bar pullout. Photos taken after steel tube was torch-cut off.

Figure 2: Flare bevel groove weld connecting reinforcing bar to steel tube. Welding performed by licensed welder. FCAW weld with E70 electrode.



Figure 3: No. 9 bars welded into tube. PVC de-bonding staggered around tube.



Figure 4: Specimens during construction, ready for concrete fill.

Instrumentation

- Load cell
- String potentiometers
- Strain gages



Figure 5: Experimental test setup photo and schematic. String potentiometers, instrumentation rod, and catch removed from schematic for clarity.



Figure 9: Typical weld region after testing. Whitewash shows no damage.

Conclusions

- Connection failure mode was reinforcing bar fracture, as desired.
- De-bonding reinforcing bar from concrete increases ductility and decreases concrete damage.

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